External Debt and Prospects for Minerals-exporting Developing Countries

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This article examines the extent to which selected non-fuel minerals-exporting developing countries can rely on their traditional source of hard-currency earnings to promote future economic growth and to facilitate payments for interest and amortization of accumulated debt. The countries (and minerals) under consideration are: Chile (copper), Bolivia (tin) and Jamaica (bauxite). Incorporated into the study are sets of alternative assumptions regarding global demand for these minerals to the end of the century, market shares, mineral prices, external debt levels and interest rates. More specifically, the study examines the likely ranges of future export revenues of these countries from these minerals in the years 1990 and 2000, and the role that these future export revenues may play in servicing external debt.

'Commodity prices may just be returning to normal after a decade on the switchback launched by the first Opec oil shock. In the 1950's and 1960's, after the Korean War, commodity prices drifted down by 10% in each decade in real terms. Prices are now about the same in real terms as they were in the early 1950's. This suggests that it was the heady excitement of the 1970's which was the exception and that commodity prices are back to their old routine.'
(*The Economist*, 24 August 1985)

'The day may not be very far off when metal products—from cars to cranes—begin to join the mechanical adding machine and the electronic vacuum tube in the museum of obsolete technology.'
(Malcolm W. Browne, in *The New York Times*, 8 December 1985)

'In the last three years, Latin America has paid the interest on its external debt by cutting back imports. It has thereby built up a large trade surplus but at the cost of very depressed economies. The modest lending that has come from banks has been offset by cutbacks in trade credit and by the flight of capital. Large trade surpluses and negligible capital inflows are obviously not sustainable much longer. Latin America's economies have to grow again and they need external capital to do so. To think otherwise is to ignore economic history.'
(Pedro-Pablo Kuczynski, in *The New York Times*, 16 December 1985)

'The major debtors are now so deeply in the hole that they cannot repay the banks without ripping apart their economic, political and social fabric. Indeed, much of this debt cannot even be serviced without usurping resources crucial to growth and development. Third world debt is simply unpayable as structured. We cannot continue to ask debtor countries to ruin their economies by putting all their dollars into debt repayment.'
(Charles E. Schumer, in *The New York Times*, 10 March 1986)

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1. INTRODUCTION

1.1 Requisites of growth and development

As the 21st century becomes more visible on the economic horizon, the process of economic growth—which Hagen (1975) defines as 'the continuing rise in average per capita income made possible by continuing increases in per capita productivity'—continues, as in the past, to dominate the concerns of policy-makers and policy-analysts in both the developed and developing countries. Development economists are almost unanimous in their opinion that the forces that contribute to economic growth and development are complicated and varied and, in most cases, reflect contrasts in history, culture, geography, resource endowments, climate and politics, not to mention differences in social and economic policy. Those responsible for designing national economic policies have often attempted to narrow the focus of economic development to one or two key variables that appear to be central to that process. In the developed economies, attention has historically been centered on increasing labor productivity as a medium- and long-term concern and maintaining moderate rates of inflation in the short term. The former requires nurturing educational, technical and scientific advances and, then, providing the economic and institutional environment to integrate these advances into the economy. The latter is addressed by a balanced set of fiscal, monetary, trade and exchange-rate policies.

In the developing countries, historically, the major focus has been on generating a savings surplus, i.e. a wedge between the value of final output (GNP) and total consumption (private and public), that can be redeployed to increase total output in the future. Development economists are accustomed to differentiating between developing countries that, on the one hand, are endowed with mineral and agricultrual resources and, on the other hand, developing countries with little or no resource base to exploit. This distinction is deliberate and well-founded: the group of resource-endowed countries are, under certain circumstances, in a position to exploit their resource base to generate foreign exchange that can be tapped to promote the development process. These potential export revenues often provide the basis and justification for massive capital flows, both direct and indirect, from the developed economies to the developing countries.

Therefore, a prerequisite for vigorous world economic growth requires sustained growth in labor productivity and price stability in the developed countries in conjunction with a consistent set of multilateral institutional agreements on trade and capital flows which are beneficial to the developing countries. If one examines world economic growth over the interval 1961-83, one observes vigorous growth from 1961 to 1973 (5% per annum), a decline in 1974-75 (1.3% per annum), a resumption in world growth from 1976 to 1979 (4.3% per annum), and then a 4-year decline in 1980-83 (1.6% per annum), from which global economic activity is just now recovering (International Monetary Fund, 1985). The 1960s and early 1970s were characterized by steady growth in labor productivity and moderate inflation rates in the developed countries, as well as extensive liberalization in trade and policies which served to increase the international mobility of capital. The two periods of global recession were characterized by excessive price inflation and low productivity growth in the developed countries which followed the two oil price increases.

2. PARTICULAR PROBLEMS FACED BY PRIMARY RESOURCE EXPORTING DEVELOPING COUNTRIES

The current trade policies of the USA, Western Europe and Japan present formidable impediments to the export of metals, textiles and agricultural products from the developing countries. These policies strain the export performance of the developing countries and, as a result, their growth potential. Unable to increase export revenues, the developing countries are being forced to slash imports and living standards in order to service the massive external debts incurred since the mid-1970s. These debt service burdens are, in turn, preventing fresh inflows of both private and official capital, thus further reducing their growth prospects. Furthermore, until recently the high nominal (and real) interest

TABLE I

Evolution of total and per capita gross domestic product of selected Latin American countries (1980-85)

	Annual growth rates[a]											
	1981		*1982*		*1983*		*1984*		*1985*		*Cumulative variation (1980-85)*	
Country	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*
Argentina	-6.7	-8.2	-6.3	-7.8	3.0	1.4	2.0	0.4	-3.0	-4.5	-10.9	-17.7
Bolivia	0.7	-1.9	-6.6	-9.1	-8.6	-11.0	-3.7	-6.3	-2.5	-5.0	-19.2	-29.4
Brazil	-2.0	-4.2	1.4	-0.9	-2.7	-4.9	4.8	2.5	7.0	4.8	8.4	3.0
Chile	5.2	3.6	-13.1	-14.4	-0.5	-2.1	6.2	4.5	2.0	0.2	-1.7	-9.1
Jamaica	2.5	1.1	-0.3	-1.6	1.4	0.0	-0.3	-1.7	–	–	–	–
Mexico	8.3	5.4	0.0	-2.6	-5.2	-7.6	3.5	0.9	3.5	0.7	9.8	-3.6
Peru	3.7	1.0	-0.2	-2.7	-12.0	-14.3	4.4	1.8	2.0	-0.4	-2.8	-14.6
Latin America[c]	0.4	-1.9	-1.5	-3.7	-2.5	-4.8	3.2	0.8	2.8	0.5	2.3	-8.9

[a] The odd-numbered columns represent changes in total GDP; the even-numbered columns denote changes in per capita GDP.
[b] Provisional estimates, subject to revision.
[c] Excluding Cuba.
Source: ECLAC, on the basis of official figures (December 1985).

rates applied to the stock of outstanding and new debt of the developing countries has placed added strains on both growth and living standards.

In addition to the above problems, many minerals-exporting developing countries are confronted with two other problems which are potentially more dangerous in their long-term implications for growth and development than those enumerated above. First is the apparent decoupling of the historical relationship between metals consumption and GNP and the second, as a consequence, is 'soft' metals prices. These two problems are examined in detail in the next three sections.

This adverse set of 'parameters'—high external debt levels, high nominal (and real) interest rates, 'weak' commodity prices, sluggish demand for mineral exports and 'protectionist' policies practised by developed economies for many primary, semi- and light-manufactured products—has already resulted in reduced and even negative growth rates in GDP and GDP per capita in some Latin American countries (Table I), and has suggested one or more of the following responses by the major debtors: a debt-service moratorium, maximum debt-service ratios, unilaterally reduced interest rates, restructuring of debt, and even debt repudiation.

The reasons for these proposed solutions by some mineral-exporting developing countries are the subject of the next three sections of this paper.

3. THE POSITION OF MINERALS IN THE WORLD ECONOMY

Before addressing the major question of this article—the future role of selected minerals exports as a vehicle for economic growth in three developing countries—a short digression is necessary to establish the position of non-fuel minerals in the framework of the world economy, and to identify likely shifts in the demand for and supply of these minerals to the end of the century.

3.1 THE DEMAND FOR METALS

The demand for metals, like the demand for any factor input, is classified as 'derived demand', that is we—as consumers—do not demand iron ore or refined copper *per se* but rather, we demand goods and services that incorporate these metals, either directly or indirectly, in their production. For example, the constituent parts of an automobile are largely metals of one kind or another.[1]

Because the demand for metals is firmly linked to the demand for goods and services, fluctuations in the latter will elicit fluctuations in the former. The behavior of commodity prices over the past 25 years lends general support to this assertion (Fig. 1). Historically, metal prices—firm

in periods of sustained world economic growth—weaken in periods of sluggish economic activity and accelerate in periods of high inflation.

In addition to the level and composition of final output acting as determinants of the demand for metals, another important factor that influences this demand is the existing technological base and the on-going process of long-term technological change.[2] The unrelenting displacement of tin by aluminum over the last 25 years, as well as the continued substitution of plastics, and—more recently—ceramics and lighter metals (such as titanium), in place of the more traditional metals in automobiles and other consumer durables, is testimony to this phenomenon. Consequently, the incorporation of technological change into the framework of determinants of demand for metals has the effect of weakening the aforementioned historical linkage between growth in GNP and increased demand for metals. Minerals economists refer to this relationship as the 'intensity-of-use'—the amount of a particular metal required per dollar of final output.[3]

Another major determinant of the global demand for primary metals is the rate of recycling of scrap metal. The effect of changes in this rate on projected consumption of selected metals for the USA to the year 2000 is described in Leontief *et al.* (1983).

As would be expected, metals consumption occurs predominantly in the developed countries. However, long-term projections indicate that the share of total metals consumption currently consumed by developed countries will decline as a result of lower 'intensity-of-use' in the developed countries and more rapid industrialization and development in developing countries.[4]

3.2 The supply of metals

The source of supply of a metal is based on a number of determinants, including: geological endowments that can be economically exploited at current prices and technology; cost-effective methods of bringing the metal to market; and assurance of uninterrupted supply in light of political and other uncertainties. Even though the USA and Western Europe do have significant resource endowments of many major minerals, because of the above considerations and the levels of consumption both are, and will continue to be, major importers of metals. The USSR, Australia, Canada and South Africa are the major developed countries which are, and will continue to be, major exporters of metals.

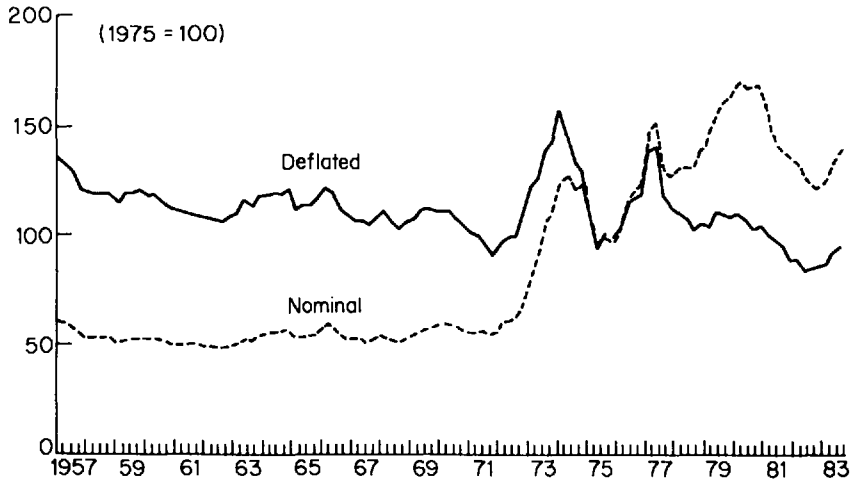

Fig. 1 Index of all non-oil primary commodity prices: nominal and real (deflated by the United Nations price index of manufactured exports of developed countries), 1957-83; 1975 = 100. (From Chu and Morrison, 1984.)

However, it is the metals-exporting developing countries—or more precisely, a selected group of these—that are the focus of this article, and it is to them that we now direct our attention.

4. MINERALS EXPORTS AS AN ENGINE OF ECONOMIC GROWTH

Minerals-exporting countries, both developed and developing, are likely to continue to utilize their endowments of mineral deposits to stimulate economic growth. Mineral exports generate foreign exchange, which is used to import modern technology and consumer durables in addition to servicing past and future external loans extended by the international lending community. As mentioned above, Australia, Canada, South Africa and the USSR are examples of minerals-exporting developed countries. Some of the developing countries which depend on minerals exports for their main source of foreign exchange include Jamaica, Saudi Arabia, Indonesia, Mexico, Venezuela, Peru, Chile and Bolivia.

The extent to which these hard currency earnings can continue to be used to promote economic growth has recently been called into question due to the evolving economic environment in the mid-1980s. This environment is one of depressed minerals prices, projections suggesting reduced growth in global demand for minerals, both fuel and non-fuel; and shifting market shares away from traditional sources towards more recently discovered (and more economic) deposits and/or more secure sources of supply. Brazil, the UK, Norway, Australia and Canada are examples of countries that have recently increased market share in certain minerals and in the process have deprived countries such as Bolivia, Saudi Arabia and Jamaica of much-needed export revenues. Moreover, current historically high real interest rates coupled with excessive external debt levels are straining the growth process in many minerals-exporting developing countries, particularly when these exports are concentrated in a single or a few commodities. In this study three minerals-exporting developing countries were selected in order to examine this problem: Bolivia (tin), Chile (copper) and Jamaica (bauxite/alumina). All three are prominent minerals exporters. According to World Bank data (World Bank, 1985b), mineral exports accounted for 80% of Bolivia's total export earnings (with tin alone accounting for about half of that). In the case of Chile (World Bank, 1984a), 50% of its total export earnings are derived exclusively from copper and in the case of Jamaica 70% of its total export earnings are derived from bauxite and alumina (World Bank, Jamaica, 1985a). Each of these countries was increasing its external indebtedness from the mid 1970s to 1983 at a rate of about 15% per annum.[5]

Simple calculations using World Bank data indicate that Bolivian export revenues from tin were 15% of debt service, Chilean export revenues from copper were 20% of debt service and Jamaican bauxite/alumina export revenues were 40% of debt service in 1983-84.[6] On the basis of the economic environment outlined above, to what extent can revenues generated by exporting these three minerals continue to play a role in enhancing future economic growth in general, and debt service in particular?

To determine the future role that these minerals are likely to play in the development process of these countries requires projections of future export revenues from these minerals and future debt-service levels. The former—future export revenues—requires the formulation of alternative assumptions regarding future global consumption of these minerals, future minerals prices and the future market shares of these countries for their exported minerals. The latter—future debt-service levels—requires the formulation of alternative assumptions regarding the growth (or reduction) in external debt, its maturity structure and future interest rates.

4.1 Projections of Global Demand

As outlined above, the global demand for minerals depends on two main determinants: the level and composition of future global GNP and the process of technological change. Long-range forecasts are periodically produced by the US Bureau of Mines, the World Bank and the United Nations, in addition to projections made by private research organizations.[7] In order to incorporate the considerable amount of uncertainty regarding the future demand of these three minerals, a consensus view of upper and lower

annual growth rates was chosen, based on the above-mentioned studies of future minerals consumption over the 20-year interval, 1980-2000, with an intermediate stop in 1990. The low, medium and high growth rates are described in Table II.

TABLE II
Projected annual growth rates in primary global consumption: 1980-2000 (percentages)

Mineral	*Low growth (L)*	*Medium growth (M)*	*High growth (H)*
Bauxite[a]	2.5	3.5	4.5
Copper	1.5	2.5	3.5
Tin	0.5	1.25	2.0

[a] Based on projections of global demand for primary aluminum and non-aluminum demand for bauxite.

Applying these alternative rates of growth in world consumption over two 10-year intervals, 1980-90, and 1990-2000, the levels of global consumption of these minerals can be computed. These are presented in Table III.

TABLE III
Alternative levels of future global consumption of bauxite, tin and copper in 1990 and 2000[a]

Year and growth assumption	*Bauxite (× 1000 tonnes)*	*Tin (× 1000 tonnes)*	*Copper (× 1000 tonnes)*
1980 (Actual)	92 830	235.6	7 860
1990 H	144 160	287.2	11 087
M	130 946	266.8	10 061
L	118 830	247.6	9 122
2000 H	223 879	350.1	15 640
M	184 712	302.0	12 879
L	152 110	260.3	10 586

[a] The growth rate assumptions H, M, and L are those appearing in Table II.

4.2 FUTURE MARKET SHARES

Turning to market shares, tin production in Bolivia (1984) was approximately 12% of world production; bauxite mining in Jamaica (1983) was about 10% of world bauxite output and copper mining (copper content) in Chile (1984) was about 15% of world output. Because virtually all bauxite and alumina produced in Jamaica and tin produced in Bolivia is exported and only 4% of copper produced in Chile is consumed domestically, exports of these minerals, are, for all intents and purposes, equal to output. These ratios are not expected to change significantly before the end of the century. However, future market shares can fluctuate considerably from current levels. For example, because of more economically exploitable tin deposits being developed in Brazil, China and Australia, Bolivia's share of total world output is expected to decline over the next 15 years. Along with continued reductions in US copper mining capacity, Chile is expected to increase its share of world output as additional copper capacity comes on stream over the next 15 years. Australia is also expected to add to its bauxite mining capacity at the expense of Jamaica, among other producing countries, until the end of the century.

Once again, because of the uncertainty of the future, a range of market shares for each mineral by these exporting countries, based on a consensus of available information, was chosen. These estimates are reproduced in Table IV.

TABLE IV
Projected market shares 1990 and 2000 (percentage of world output)

Country	*Low share*	*Medium share*	*High share*
Bolivia (tin)	0.06	0.09	0.12
Chile (copper)	0.10	0.15	0.20
Jamaica (bauxite)	0.08	0.13	0.18

4.3 FUTURE MINERAL PRICES

The greatest uncertainty of all the projected parameters in this study is the future price of minerals. Even though minerals prices are intrinsically unstable, for the purposes of forecasting project profitability, private mining companies make projections of minerals prices over a 10-year horizon. Some international institutions, viz. the World Bank and the International Monetary Fund, periodically forecast future minerals prices for the purposes of assessing the financial aspects of a development or structural adjustment loan to a member country. Historical prices for bauxite, copper and tin and their future prices as projected

by the World Bank (1984b) are given in Table V. As in the case of future minerals consumption and future market shares, because of the high degree of uncertainty regarding future prices, three different future prices are used in this study to calculate future export revenues. The ranges used approximate the volatility of minerals prices in the past, corrected for inflation. The future prices assumed in this study are given in Table VI.

TABLE V
Historical and projected prices of bauxite, copper and tin: 1960-95 (constant 1983 US dollars)

Year	*Bauxite*[a] *($ tonne^{-1})*	*Copper*[b] *($ lb^{-1})*	*Tin*[c] *($ lb^{-1})*
1960	23.70	0.97	3.16
1970	28.30	1.51	3.93
1980	49.80	1.20	9.21
1983	34.70	0.72	5.90
1990[d]	37.10	0.72	5.95
1995[d]	39.00	0.78	6.04

[a] Jamaican Bauxite; per dry tonne, CIF US port.
[b] London Metal Exchange, refined copper.
[c] London Metal Exchange, settlement price, standard grade.
[d] World Bank projection
Source: World Bank (1984b).

TABLE VI
Assumed minerals price 1990 and 2000 (constant 1983 US dollars)

Mineral[a]	*High*	*Medium*	*Low*
Bauxite ($ tonne^{-1})	50.00	37.50	25.00
Copper ($ lb^{-1})	1.20	0.97	0.75
Tin ($ lb^{-1})	9.00	6.00	3.50

[a] See footnotes (a)-(c) of Table V.

4.4 PROJECTED EXTERNAL DEBT AND DEBT SERVICE

Starting with 1985 levels of external debt for Chile, Bolivia and Jamaica (Table VII), the stock of future external debt can increase, remain constant or decrease.[8] An increasing stock of debt, *ceteris paribus*, requires annual increases in interest payments. A constant future stock of external debt (i.e. a rate of growth equal to zero), *ceteris paribus*, requires constant annual interest payments; a reduction in external debt, i.e. amortization of principal, would require, *ceteris paribus*, declining levels of annual interest payments. Any one of these possible paths could be chosen by these countries upon agreement with their creditors.

For the purposes of this article, under the assumption of growth in external debt to the year 2000, two growth rates have been applied: the first approximating the rate of growth in external debt experienced over the period 1975-83, and a second, more moderate rate, equal to one-half of the 1975-83 growth rate. The path of constant external debt simply requires annual interest payments on that constant stock. The last alternative considered—reduction in external debt—is structured to eliminate external debt completely by the year 2000. The mechanism for carrying this out over the 15-year interval is akin to a 15-year amortized mortgage, whereby the constant annual payments simultaneously reduce the annual stock of debt outstanding and services the remaining debt in each year. These alternatives are summarized in Table VII.

TABLE VII
Actual and projected external debt levels (millions 1985 US dollars)

Year and assumption	*Jamaica*	*Chile*	*Bolivia*
1985 (Actual)	3120	21 000	4000
1990 (Projected)			
HH	6550	42 200	7050
H	4580	30 100	5350
M	3120	21 000	4000
L	Amortization	Amortization	Amortization
2000 (Projected)			
HH	28 890	170 900	21 890
H	9900	62 100	9590
M	3120	21 000	4000
L	0	0	0

The designation 'HH' in Table VII represents a growth rate in external debt that approximates the growth rate, *per annum*, during the interval 1975-83: for Jamaica it was 16%; for Chile it was 15%; and for Bolivia it was 12%. The second assumption, 'H', represents a more moderate growth rate in external debt equal to half of the growth rate in external debt over the interval 1975-83. Therefore, the corresponding annual growth rates in scenario H for Jamaican, Chilean and Bolivian external debt are, 8%, 7.5% and 6%, respectively. The assumption of *zero*-growth in external debt over the period 1985-2000 is incorporated in the line beginning with 'M'. The last designation, 'L', is the assumption of total debt amortization by the year 2000.[9] In this case because annual payments are structured to pay down principal as well as service the remaining principal, the stock of debt in 1990, in and of itself, is not relevant to determine 1990 and 2000 interest payments.[10]

4.5 Future interest rates

Applying an interest rate to projected stocks of external debt in 1990 and 2000 will determine interest payments in those target years.[11] Historically, LIBOR rates (London Inter-Bank Offer Rate) over the past 15 years have averaged between 3% and 5%, in *real* terms (Fig. 2). Most international loans, especially those to developing countries, require additional charges, ranging from 1% to 2½% to be added to the LIBOR rate, reflecting risk and profit premiums. These are the appropriate rates charged to so-called 'market borrowers' such as Chile and Bolivia.[12] Countries, such as Jamaica, which are considered 'official borrowers' are entitled to concessionary borrowing terms, reflected, in part, through reduced rates of interest.[12] Table VIII presents the high, medium and low range of assumed (real) interest rates incorporating (high and low)

Table VIII
Assumed real interest rates (%)

Country	*High*	*Medium*	*Low*
Bolivia	7.50	5.75	4.00
Chile	7.50	5.75	4.00
Jamaica	5.50	3.75	2.00

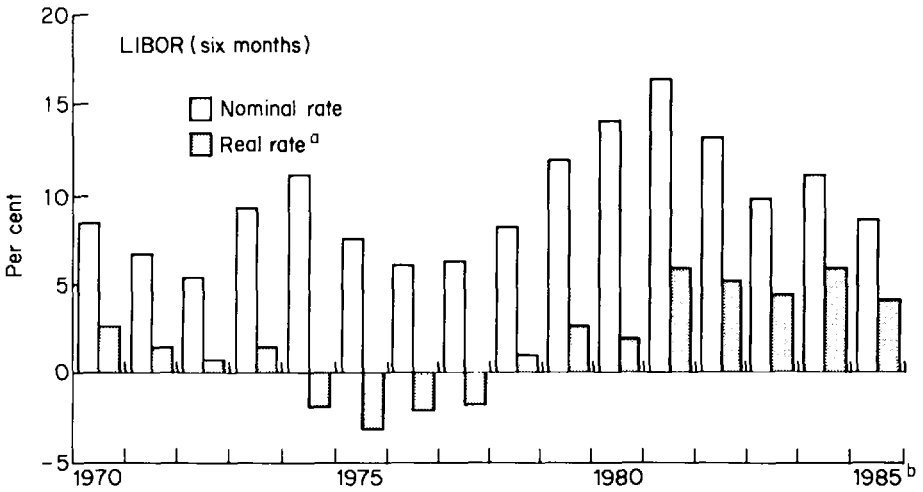

Fig. 2 International interest rates (percentages). [a]Nominal rate deflated by the consumer price index of the industrialized countries. [b]Average, January-November. (Source: ECLAC, from data from Morgan Guaranty Trust, *World Financial Markets*, *Economic Report of the President*, Washington, February 1985, and International Monetary Fund, *International Financial Statistics*.)

risk and profit premiums and, in the case of Jamaica, concessionary interest rates to reflect its status as an official debtor.[13] Current concessional rates, according to the IMF (International Monetary Fund, 1985), are about 2% below commercial lending rates.[14]

Given these hypothetical—though not implausible—sets of alternative assumptions about the future values of these key parameters (growth rates in global consumption of minerals, market shares, minerals prices, levels of external debt and real interest rates) we are now in a position to shed some light on the future contribution of these minerals exports to debt service in particular, and economic growth in general, for Chile, Jamaica and Bolivia.

TABLE IX

Future export revenues and utilization rates of expected future annual installed capacity in the year 2000: Chile (copper)

Scenario[a]			*Export revenues (millions 1983 US dollars)*	*Utilization rate of expected future annual installed capacity (%)*[b]
Market share	*Growth in global demand*	*Price*		
H	M	M	5500	117
H	L	M	4520	96
H	M	L	4250	117
H	L	L	3490	96

[a] See note 16.

[b] This computation is based on World Bank projections of 2.2 million tonnes year^{-1} installed capacity in the year 2000.

5. FUTURE EXPORT REVENUES, DEBT SERVICE AND ECONOMIC GROWTH

Permuting the three assumptions for each of the three key parameters that comprise mineral export revenues—growth in global demand, market shares and mineral prices—provides an interval over which minerals export revenues for these three countries are likely to range in 1990 and 2000.[15] A similar permutation of the various assumptions for each of the key parameters that comprise debt service—future growth rates in external debt and future rates of interest—provides an interval over which debt service levels for Chile, Jamaica and Bolivia are likely to range in 1990 and 2000. The entire set of these two permutations is presented in Tables 1 and 2 of the Annex. In this section, a summary of some of the highlights of these calculations for the year 2000 is presented.

5.1 COPPER AND CHILE IN THE YEAR 2000

A small sample of some of the outcomes which seem most likely to incorporate the range of Chilean export revenues from copper, given the economic and technical constraints which are now, or likely to be, in place by the year 2000, have been selected for inclusion in Table IX.[16]

The World Bank has projected that Chile's annual installed copper capacity will be 2.2 million tons by the year 2000 (World Bank, 1984b). If we restrict the range of future export revenues to those scenarios with medium and low assumptions of world demand for copper, expected capacity utilization rates assume reasonable dimensions, ranging from 96% to 117% of expected future installed annual capacity. The range of annual revenues from copper exports would be between US $3490 and $5500 million (1983 dollars), depending on the future price of copper. According to the World Bank (World Bank, 1984a), average revenues for Chilean copper exports from 1981 to 1983 were $1760 million.

Most mineral economists believe that world demand for copper will grow at the medium rate, 2.5% per annum until the end of the century; they foresee Chile expanding its market share to 20% of world copper output; and they do not think it likely that future copper prices will be equal to $1.20 lb^{-1} *(1983 dollars).

Table X presents a selection of annual debt service requirements, i.e. interest payments, for the year 2000 that were selected from the complete list which appears in Table 2 of the Annex. Only the subset of debt and interest rate positions that appears to be consistent from the point of view of the international lending community were selected for inclusion in Table X. The last two columns of this table present the ratio of alternative projected debt service levels to the likely low and high range of projected copper export earnings of Chile in the year 2000, $3490-5500 million.

*1 lb = 454 g (approx.).

TABLE X
Chilean debt service scenarios in the year 2000

Scenario[a]		Debt service	Debt service[b]	
			Copper exports	
Interest rate	Debt level	(millions 1985 US $)	L	H
H	H	4660	1.34	0.85
H	M	1570	0.45	0.28
M	H	3570	1.03	0.65
M	M	1210	0.35	0.22
L	H	2480	0.71	0.45
L	M	840	0.24	0.15

[a] See note 16.
[b] For this calculation the projected range of copper export revenues of $3490-5500 million was used. L denotes a denominator of $3490 million and H a denominator of $5500 million.

While it would be unlikely for Chile's external borrowings to increase at the 1975-83 rate of 15% per annum, in the light of the so-called Baker Plan Initiative, assumptions ranging from indefinite roll-over of existing debt (assumption M) to more moderate growth in external debt of 7½% per annum (assumption H) should not be ruled out. Less likely to occur would be a deliberate policy of debt amortization by the year 2000, because of the substantial sacrifices in economic growth this policy would require early in the amortization schedule. [Chilean merchandise exports in 1984 were approximately $4000 million, equal to about 60% of the calculated annuity payments at the high (7.5%) real annual interest rate.]

Under the low copper export-revenue assumption ($3490 million) for the year 2000, combined with positive growth in external debt (assumption H), debt service in the year 2000 is likely to consume 71-134% of export earnings from copper. If copper continues to maintain its present position in the structure of Chile's exports, i.e. 46% of the total, interest payments in the year 2000 will consume 33-62% of total merchandise export earnings. Total debt service—interest and principal payment—were 43% of exports in 1983.

Under the high copper export-revenue assumption ($5500 million) for the year 2000, coupled with positive growth in external debt, debt service in the year 2000 is likely to consume 45-85% of export earnings from copper. If copper continues to maintain its present position in the structure of Chile's exports, i.e. 46% of the total, then interest payments in the year 2000 will consume 21-39% of total merchandise export earnings.

Therefore, assuming moderate growth in external debt to the year 2000, i.e. the Baker Plan Initiative, any improvement in Chile's debt service burden and, as a result, its ability to restore annual economic growth to pre-1980 levels, is virtually foreclosed, without a significant change in the most likely set of assumptions outlined above. These assumptions govern export revenues (world demand for copper, Chile's market share, copper prices and the structure of exports) and the level of interest rates.

5.2 BAUXITE AND JAMAICA IN THE YEAR 2000

Table XI presents a sample of some of the outcomes which seem most likely to incorporate the range of Jamaican export revenues from bauxite, given the projected technical capacity constraints and future economic prospects.[17]

TABLE XI
Future export revenues and utilization rates of expected future annual installed capacity in the year 2000: Jamaica (bauxite)

Scenario[a]			Export revenues (millions 1983 US dollars)	Utilization rate of expected future annual installed capacity (%)[b]
Market share	Growth in global demand	Price		
L	H	M	670	79
L	M	M	550	66
L	H	L	450	79
L	M	L	370	66

[a] See note 16.
[b] Bauxite production capacity for Jamaica in the year 2000 is assumed to be 22 750 tmt.

Recent World Bank projections for bauxite/alumina/aluminum (World Bank 1984b) assume 1990 global bauxite capacity to be in the neighborhood of 123 210 tmt, with Jamaican capacity projected to be 16 125 tmt (13% of projected global capacity). Assuming that both global and Jamaican bauxite capacity expand at an annual

rate of 3.5% until the year 2000, capacity constraints will limit Jamaican bauxite production to a level of approximately 22 750 tmt in that year. Few, if any, minerals experts believe, given the current economics of the world bauxite industry, that Jamaica can capture 18% of the global market of bauxite in the year 2000, i.e. the high market share assumption. Most minerals economists are of the opinion that Jamaica will continue to lose market share to other producers of bauxite and, as a result, the most probable market share of Jamaica in the year 2000 will be 8% of the total, corresponding to the low assumption. In addition, most minerals economists project global demand for bauxite to be in the medium to high range (3.5-4.5% per annum). Therefore, the projected rates of utilization of installed annual capacity in the year 2000 would range between 66% and 79%. Consequently, the relevant interval of future Jamaican bauxite revenues in the year 2000 will most probably be between $370 and $670 million, scenarios L,M,L, L,H,M, L,M,M and L,H,L. Average bauxite/alumina export revenues of Jamaica over the 1981-83 interval, according to the World Bank (World Bank, 1984a), were $565.9 million.

Turning to future debt service, the range in the year 2000 (Table 2 in the Annex) including the highly unlikely scenarios of sustained rapid debt accumulation at high interest rates (scenario H,HH) and of systematic amortization of the stock of 1985 external debt, would be between $62.4 million and $1588.9 million. Table XII presents a sample of the more likely levels of required interest payments by Jamaica in the year 2000.

TABLE XII
Jamaican debt service scenarios in the year 2000

Scenario		*Debt service*	*Debt service*[a]	
Interest rate	*Debt level*	*(millions 1985 US $)*	*Bauxite exports*	
			L	*H*
H	H	544.5	1.46	0.81
M	H	371.2	1.0	0.55
L	H	198.0	0.53	0.29

[a] For this calculation a projected range of bauxite revenues of $370-670 million was used. L represents the lower figure and H represents the higher figure.

While it would be unlikely for the international lending community to permit the external debt of Jamaica to grow at 16% per annum, more modest increases in external debt are highly probable (scenarios H,H, M,H and L,H). Given the poor prospects for its bauxite export revenues and the excessive proportion of total exports concentrated in bauxite (70% in 1984), Jamaica may be unable to gain any fresh external capital from the international lending community, represented as scenarios H,M, M,M and L,M in Table 2 in the Annex. On the other hand, the political and economic difficulties that would result from this policy would remove them from consideration. Therefore, depending on future export revenues, future interest payments are likely to range between 29% and 146% of bauxite exports in the year 2000. If the current structure of Jamaican exports is maintained in the year 2000, i.e. bauxite/alumina exports are 70% of total merchandise exports, then interest payments are likely to consume between 20.3% and 102.0% of total merchandise export revenues in the year 2000. Total debt service of Jamaica in 1984 was, according to the World Bank, equal to 51.8% of exports.

Therefore, in the year 2000, without a major change in the most probable set of assumptions that generate Jamaican export revenues (world demand for bauxite, Jamaica's market share, bauxite prices, and the structure of exports) even with the Baker Plan Initiative of increased external credits, Jamaican growth rates are likely to approximate only the levels achieved so far over this decade. This is due in large part to the excessive debt service levels that they now face and will continue to face in the future.

5.3 TIN AND BOLIVIA IN THE YEAR 2000

Following the same procedure as in the two previous cases, a sample of some of the possible levels of future export revenues of Bolivia from tin are reported in Table XIII.[18] Those levels represent the scenarios most likely to incorporate the range of Bolivian export revenues from tin, given projected capacity constraints and, more generally, future economic prospects.[19] A recent World Bank report (World Bank, Price Prospects, 1984b) estimates that annual Bolivian tin

TABLE XIII
Future export revenues and utilization rates of expected future annual installed capacity in the year 2000: Bolivia (tin)

Scenario[a]			Export revenues (millions 1983 US dollars)	Utilization rate of expected future annual installed capacity (%)[b]
Market share	Growth in global demand	Price		
M	M	M	360	85
M	L	M	310	73
M	L	L	180	73
L	M	M	240	57
L	M	L	140	57
L	L	M	210	50
L	L	L	120	50

[a] See note 16.
[b] Annual capacity of 32 000 tonnes is assumed for the year 2000.

capacity, currently 24 000 tonnes, will increase about 2% per annum, to an annual level of 32 000 tonnes by the year 2000. On the other hand, the general consensus among mineral economists is that growth in global demand for tin is expected to be less than 2% per annum, and probably closer to zero. With this in mind and the lower-cost capacity being built in Brazil and Australia, the assumptions of high growth in global demand, high world prices and high market share for Bolivia are not justified in projecting future Bolivian export revenues from tin. Consequently, export revenues of tin are likely to range between $120 and $360 million in the year 2000. [According to the World Bank, tin exports of Bolivia averaged $290 million during 1981-83 (World Bank, Bolivia, 1985b)]. This range would imply capacity utilization rates equal to 50-85% of future installed capacity—certainly within the range of feasible operating rates. The corresponding utilization rate for 1983 was 71% (World Bank, 1985b).

Turning to debt service in the year 2000 (Table 2 in the Annex), including the unlikely scenarios of sustained rapid debt accumulation (our HH assumption) of 12% per annum, debt service payments will range between $160 million and $1642 million. After removing from consideration, for either economic or political reasons, the scenarios assuming sustained rapid debt accumulation, zero growth in external debt and debt amortization, the range of debt service takes on more feasible proportions; $384-$714 million (see Table XIV). Under the so-called Baker Plan Initiative—which would result in a resumption of economic growth by moderate growth in external debt—a 6% annual growth in Bolivian debt (the H assumption), in conjunction with low interest rates applied to that future stock of debt, would result in a level of debt service that, even under the high export revenue assumption, would consume 110% of tin exports. If tin continues to maintain its present position in the structure of Bolivian exports, i.e. 35%, debt service levels under these assumptions would reach 38% of total exports, approximately the same level as today.

TABLE XIV
Bolivian debt service scenarios in the year 2000

Scenario		Debt service	Debt service[a]	
			Tin exports	
Interest rate	Debt level	(millions 1985 US $)	L	H
H	H	719.2	6.0	2.0
M	H	551.4	4.6	1.5
L	H	383.6	3.2	1.1

[a] These calculations are based on a range of tin export revenues between $120 million (L) and $360 million (H).

Therefore, the prospects for restoring economic growth to Bolivia in the future are formidable. Barring any significant changes in the assumptions that are used in this study to project Bolivian export revenues in the year 2000 (world demand for tin, Bolivian market share, tin prices and the structure of exports), even after allowing for growth in external debt, i.e. the Baker Plan Initiative, debt service burdens will continue to cripple efforts to enhance living standards in Bolivia until the end of the century.

6. SUMMARY AND CONCLUSIONS

If the assumptions regarding the future values of the key parameters that determine the levels of mineral export revenues and debt service of these three developing countries are accepted, what are some of the conclusions that can be drawn regarding the prospects for future economic

growth in these three countries and, more specifically, the role that mineral exports are likely to play in that process?

It is taken as almost axiomatic by economists and politicians alike that the restoration of economic growth in developing countries must be preceded by increased capital inflows. However, before new capital can flow to these countries the investment community requires guarantees, in one way or another, of an acceptable return on that capital, i.e. profits on direct investments or interest and principal payments on loans extended. The necesssity to introduce market-oriented reforms—a *quid pro quo* in the recently formulated Baker Plan Initiative to extend new capital to the poorest developing countries—is certainly made in this light.

As far as the mineral exports of the three countries analyzed in this study are concerned, if we assume moderate growth in external debt, i.e. the assumption implicit in the Baker Plan, under the most favorable (and feasible) set of assumptions for the year 2000, interest payments—not to mention payments on principal—will continue to make significant, and perhaps unsustainable, claims on total exports in general, and without a deliberate policy of export diversification, on mineral exports in particular[20].

In the case of Chile—under a scenario of a world market share of 20%, annual growth in world demand for copper of 2.5%, copper prices of \$0.97 lb^{-1} (1983 dollars) and low real interest rates applied to the moderately growing stock of external debt, interest payments will absorb 45% of copper export revenues, and assuming that the current structure of Chilean exports will remain constant, interest payments will consume 21% of total exports.

Turning to Jamaica, under the most favorable scenario given the realities of the projected position of Jamaica in the world bauxite market—an 8% share of the world bauxite market, a 4.5% annual growth in bauxite consumption and a price of \$37.50 $tonne^{-1}$ (1983 dollars)—interest payments (generated by a low interest rate applied to a moderately growing stock of debt) will absorb 29% of bauxite export revenues and more than 20% of total export revenues, assuming that the structure of Jamaican exports remains at its 1985 level.

Finally, looking at Bolivia, assuming moderate growth in external debt and applying an assumed low rate of interest to it, annual interest payments in the year 2000 would reach \$383.6 million. Given the global prospects for the demand for tin in general, and Bolivian tin in particular, the level of required interest payments in the year 2000 would absorb 110% of tin export revenues under the best of circumstances—global tin demand of 1.25% per annum, a 9% market share of tin, and tin prices equal to \$6.00 lb^{-1} (1983 dollars). Under the more probable set of revenue assumptions—world tin demand growing at only 0.5% per annum, a reduced market share for Bolivia of 6% of the total and world tin prices of \$3.50 lb^{-1} (1983 dollars), the required interest payments in the year 2000 would consume 320% of tin export revenues. With tin currently representing about 35% of Bolivian exports, if we assume an unchanged export structure the required interest payments in the year 2000 could, if the most probable assumptions prevail, absorb all Bolivian export revenues and more.

Therefore, in all three cases, even with the incorporation of the Baker Plan Initiative, because of the heavy concentration of these minerals in the export structure of these three countries, the prospects for restoring the rate of economic growth to its pre-1980 level are extremely small without major changes in the sets of assumptions used in this study. Consequently, the Baker Plan, as it has been formulated, may not be the solution for improving economic growth and living standards in these countries.

Obviously, logic then leads us to the path of export diversification. However, a policy of expansion of non-mineral exports requires that markets of the developed countries be open to these new 'non-traditional' exports as long as price and quality standards are met. These assurances of market accessibility would have to be codified within the institutional structure of the international trading system, i.e. GATT, and would have to be sufficiently strong so as to overcome all impediments that can be subsumed under the rubric of 'protectionism'. Finally, the agreement would ultimately require deliberate and long-term structural adjustments in developed countries as well, a subject that goes beyond the scope of this study.

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NOTES

1 For a technical description of the direct and indirect metal requirements needed to produce a $1000 million (1972 dollars) of output for each of 85 producing sectors of the US economy, see Leontief *et al.* (1983). Analogously, for the direct and indirect metal requirements needed to deliver $1000 million (1972 dollars) of final output to various GNP categories, i.e. consumption, investment, etc., also see Leontief *et al.* (1983).

2 In order to simplify the present discussion of technological change, all of the following channels of change are subsumed under the rubric of technological change: materials substitution, the introduction of new products or techniques, conservation, down-sizing, down-weighting and miniaturization, etc.

3 See Malenbaum (1978) for a description of this concept.

4 For a more detailed discussion of these projected changes, see Leontief *et al.* (1983).

5 Calculations based on recent World Bank data (World Bank 1984a, 1985a,b), imply annual growth rates of external debt of 16% for Jamaica, 12% for Bolivia and 15% for Chile.

6 According to the World Bank (1984a, 1985a,b), the debt service ratios for Bolivia (1983), Chile (1983) and Jamaica (1984) were 41%, 43% and 57.8%, respectively.

7 The projections of three recent studies are summarized in Tables 7-66 of Leontief *et al.* (1983).

8 This figure includes short- and long-term, private and official debt. Approximate levels of total external debt in 1985 were: Chile $21 000 million; Bolivia $4000 million and Jamaica $3120 million.

9 Another scenario could be structured to pay-down only a part, i.e. half, of the 1985 stock of external debt. This would obviously reduce annual debt service, and could be more politically palatable. This is discussed at more length in Section 5.

10 The general equation for calculating the annual payments to amortize a loan is the following:

Present value of the loan = Annual payments x PVIFA (n,k).

11 For the purpose of simplicity I refer to these interest payments as debt service. The formal definition of debt service includes repayment of principal on maturing debt, in addition to payments of interest on outstanding debt. Therefore, for example, an assumption of constant external debt over the 15-year interval assumes that new loans are extended, equal in amount to those maturing throughout the interval.

12 The IMF classifies countries as 'market borrowers' if two-thirds or more of their external borrowings are from commercial creditors. On the other hand, 'official borrowers' derive more than two-thirds of their external borrowings from official creditors.

13 For the purposes of this paper, the interest rate applied to the outstanding stock of debt is considered to be an average real rate on the entire portfolio of debt.

14 The appropriate PVIFA factors (see note 10) to be applied to the 15-year annuity are as follows:
Bolivia and Chile: 8.833, 9.879 and 11.118 for the H, M, and L rates of interest, respectively;
Jamaica: 10.046, 11.323, 12.849 for the H, M, and L rates of interest, respectively.

15 As stated in footnotes a, b, and c of Table V, the prices used in the calculations which follow are for Jamaican bauxite, refined copper, and standard-grade tin. Even though only about 70% of total mine output of copper is shipped from Chile as refined copper—the rest being shipped as concentrate or matte—the computed future export revenues, based on the export price of refined copper, are, as a result, overstated. As for Jamaica, about 75% of the bauxite output is shipped as bauxite and the remainder as alumina. Consequently, future Jamaican export revenues of bauxite will be understated as a result of computing with bauxite prices.

16 Throughout this section the same order in scenario assignations as appear in Tables 1 and 2 of the Annex are used. For example, H,M,M in Table IX is the scenario which assumes high market share, medium growth in world demand and medium prices.

17 See note 16.
18 The complete set of alternative levels of future export revenues is presented in Table 1 of the Annex.
19 See note 16.
20 These percentages are based on the 'H' assumption of mineral export revenues in Tables X, XII and XIV, and interest payments are calculated by assuming *low* real interest rates.

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ANNEX

TABLE 1

Export revenues in 1990 and 2000 under alternative assumptions regarding market share, growth in global consumption of minerals and minerals prices (millions 1983 US dollars)[a]

Scenario			Jamaica (Bauxite)		Bolivia (Tin)		Chile (Copper)	
Market share	Growth in global demand	Price	1990	2000	1990	2000	1900	2000
H	H	H	1297.4	2014.9	682.3	831.8	5853.9	8257.9
H	M	H	1178.5	1662.4	633.8	717.8	5312.5	6800.4
H	L	H	1069.5	1369.0	588.3	618.5	4816.4	5589.4
M	H	H	937.0	1455.2	511.8	623.9	4390.0	6193.4
M	M	H	851.1	1200.6	475.4	538.2	3984.3	5100.3
M	L	H	773.0	988.7	441.1	463.9	3612.3	4192.1
L	H	H	576.6	895.5	341.2	415.9	2926.9	4129.0
L	M	H	523.8	738.8	316.9	358.8	2656.2	3400.2
L	L	H	475.3	608.4	294.1	309.2	2408.2	2794.7
H	H	M	973.1	1511.2	454.8	554.5	4731.9	6675.1
H	M	M	883.9	1246.8	422.5	478.5	4294.2	5496.9
H	L	M	802.1	1026.7	392.2	412.4	3893.3	4518.1
M	H	M	702.8	1091.4	341.2	415.9	3553.4	5006.4
M	M	M	638.4	900.5	316.9	358.8	3220.7	4122.7
M	L	M	579.3	741.5	294.1	309.3	2919.9	3388.6
L	H	M	432.5	671.6	227.5	277.3	2366.0	3337.6
L	M	M	392.8	554.1	211.3	239.2	2147.1	2748.5
L	L	M	356.5	456.3	196.1	206.2	1946.6	2259.0
H	H	L	648.7	1007.5	265.3	323.5	3658.7	5161.2
H	M	L	589.3	831.2	246.5	279.1	3320.3	4250.2
H	L	L	534.7	752.4	228.8	240.5	3010.3	3493.4
M	H	L	468.5	727.6	199.0	242.6	2744.0	3870.9
M	M	L	425.6	600.3	184.9	209.3	2490.2	3187.7
M	L	L	386.2	494.4	171.6	180.4	2257.7	2620.0
L	H	L	288.3	447.8	132.7	161.7	1829.4	2580.6
L	M	L	261.9	369.4	123.2	139.5	1660.1	2125.1
L	L	L	237.7	304.2	114.4	120.3	1505.1	1746.7

[a] The letters, H, M, and L correspond to the assumptions listed in Tables IV, II and VI, respectively, of the main text.

TABLE 2

Required interest payments in 1990 and 2000 under alternative assumptions regarding real interest rates and external debt levels (millions 1985 US dollars)

Interest rates	*Debt levels*	*Jamaica*		*Bolivia*		*Chile*	
		1990	*2000*	*1990*	*2000*	*1990*	*2000*
H	HH	360.2	1588.9	528.7	1641.7	3165.0	12817.5
H	H	251.9	544.5	401.2	719.2	2257.5	4657.0
H	M	171.6	171.6	300.0	300.0	1575.0	1575.0
H	L	310.6	310.6	452.8	452.8	2380.0	2380.0
M	HH	245.6	1083.4	405.4	1258.7	2426.5	9826.7
M	H	171.7	371.2	307.6	551.4	1730.7	3570.7
M	M	117.0	117.0	230.0	230.0	1207.5	1207.5
M	L	275.5	275.5	404.9	404.9	2130.0	2130.0
L	HH	131.0	577.8	282.0	875.6	1688.0	5836.0
L	H	91.6	198.0	214.0	383.6	1204.0	2484.0
L	M	62.4	62.4	160.0	160.0	840.0	840.0
L	L	242.8	242.8	359.8	359.8	1890.0	1890.0

[a] The letters HH, H, M and L correspond to the assumptions listed in Tables VIII and VII, respectively, of the main text.